

Fig.1

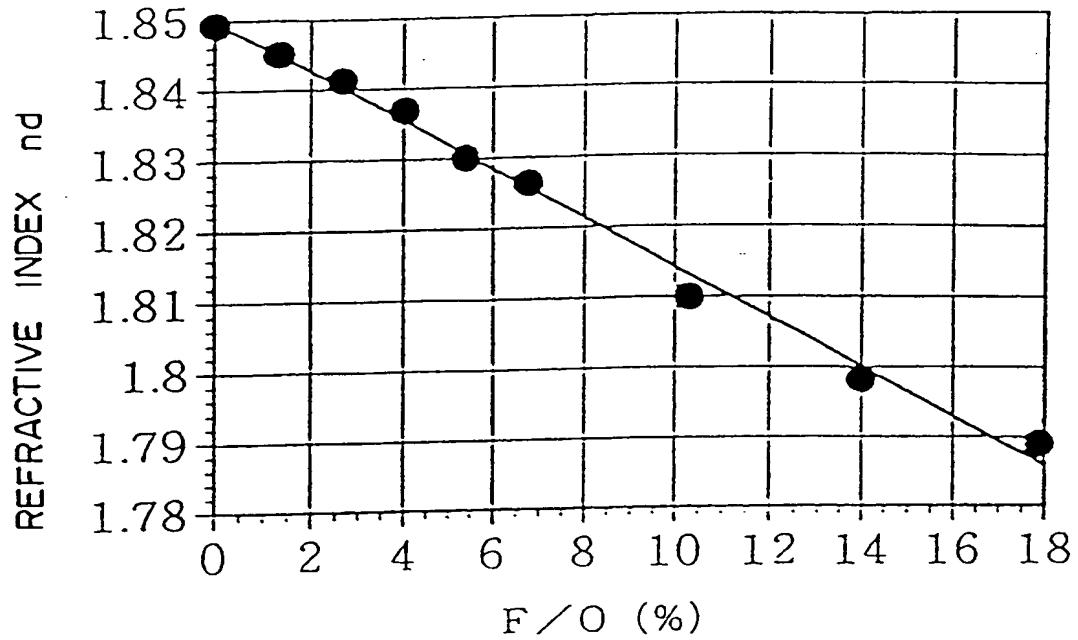


Fig.2

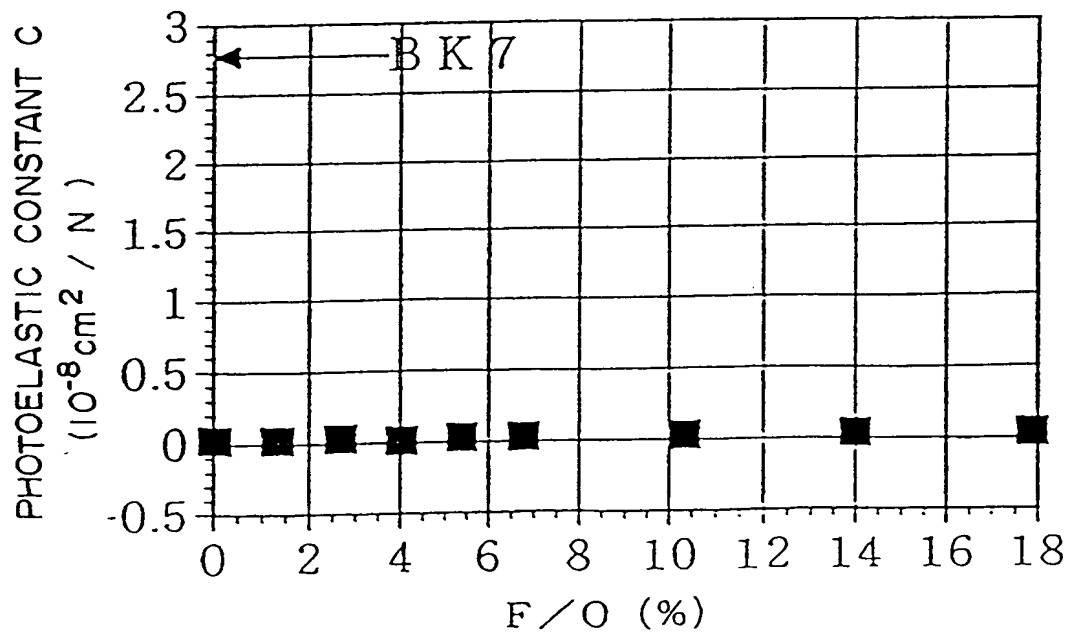


Fig.3

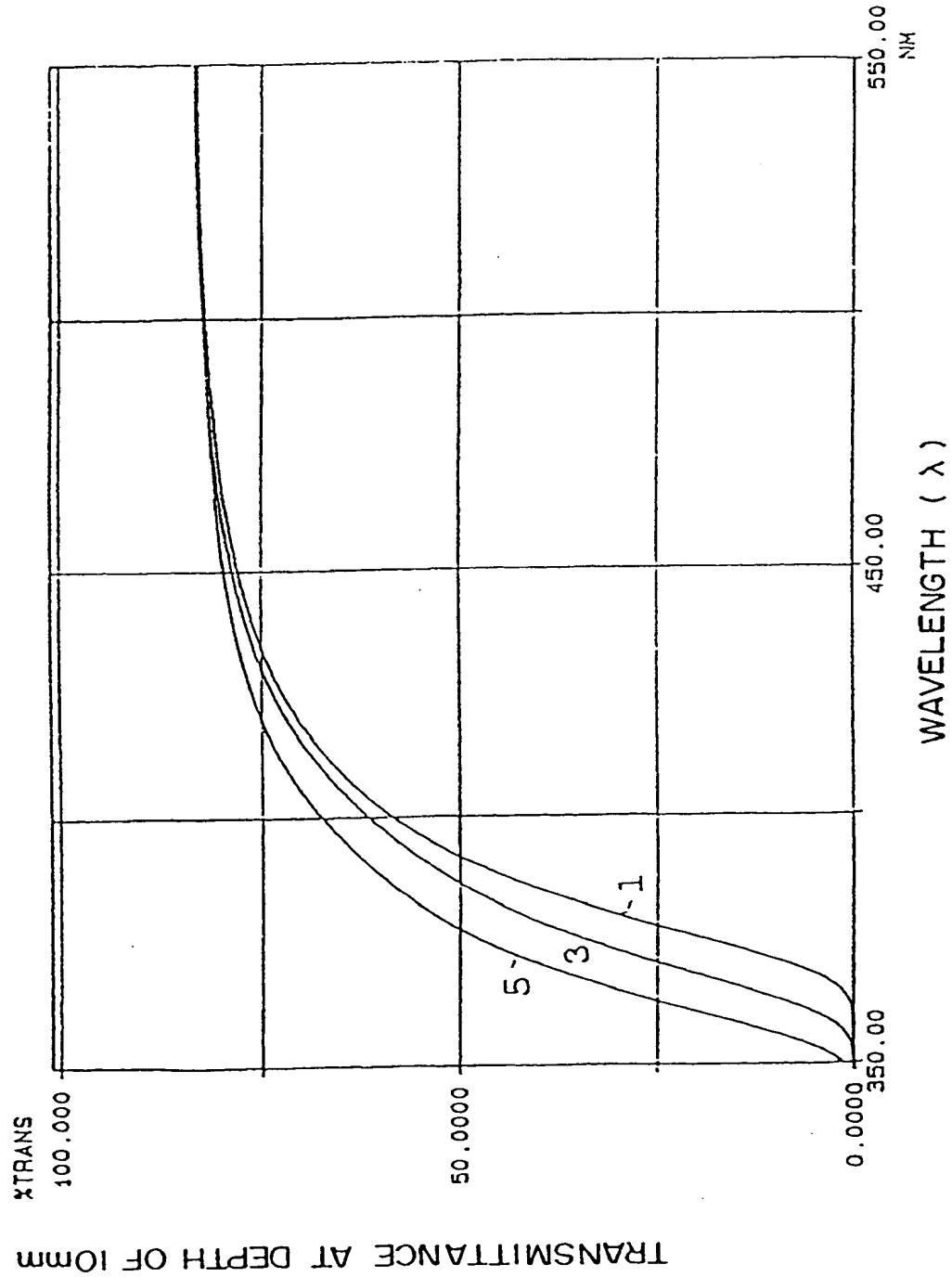


Fig.4

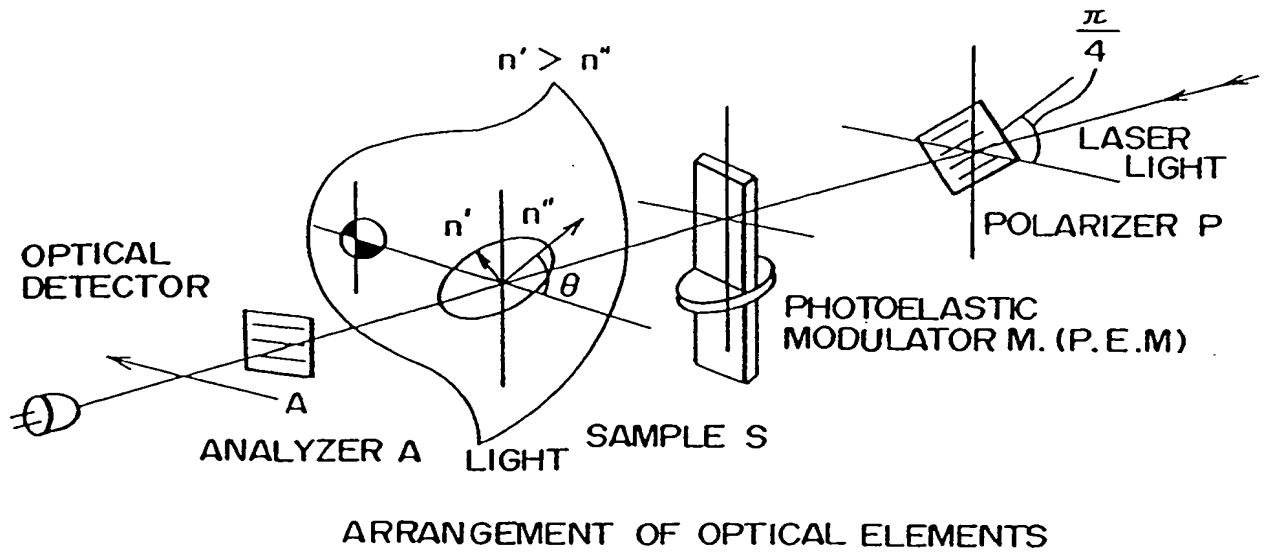


Fig.5

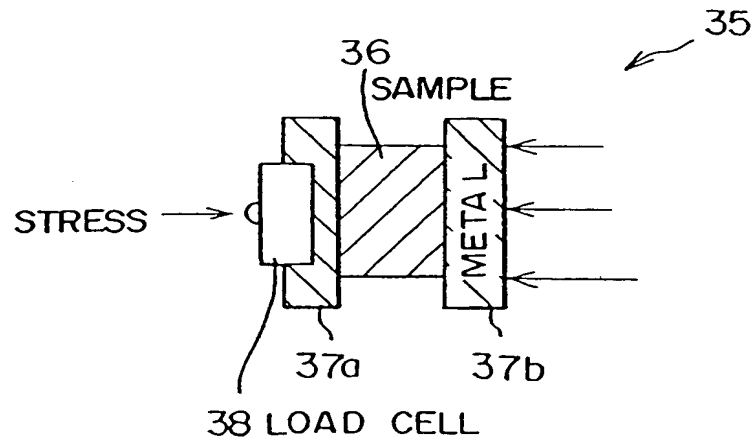


Fig.6

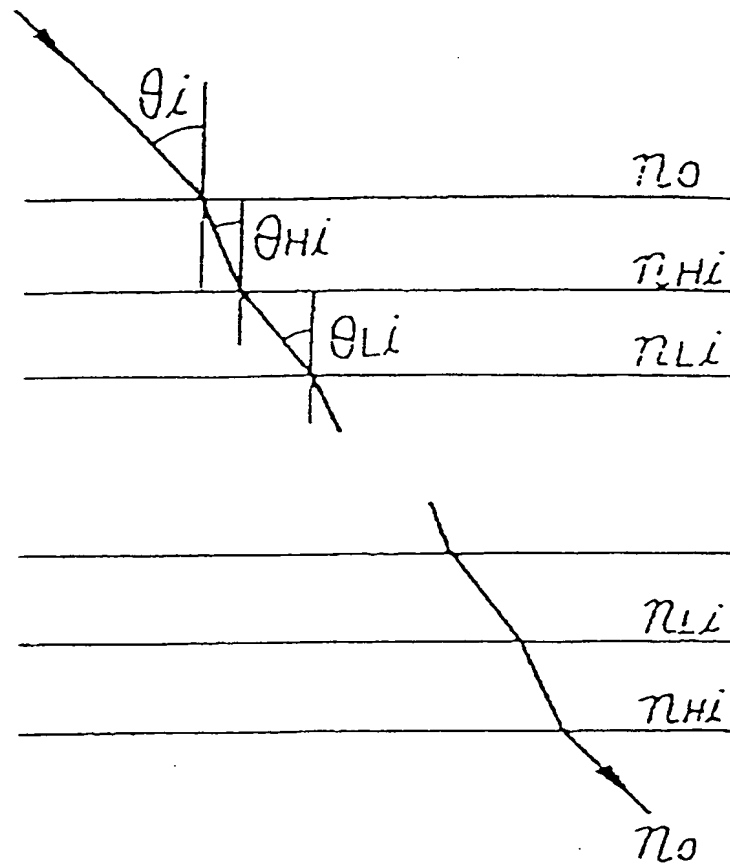


Fig.7

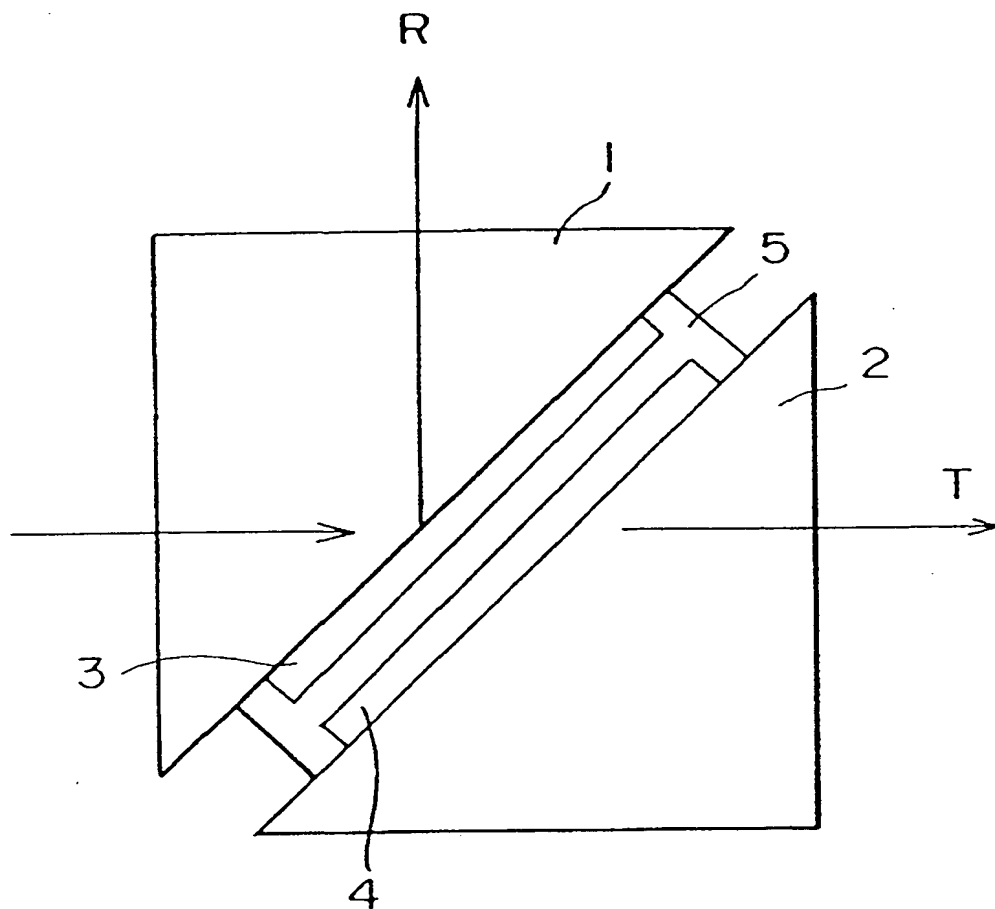
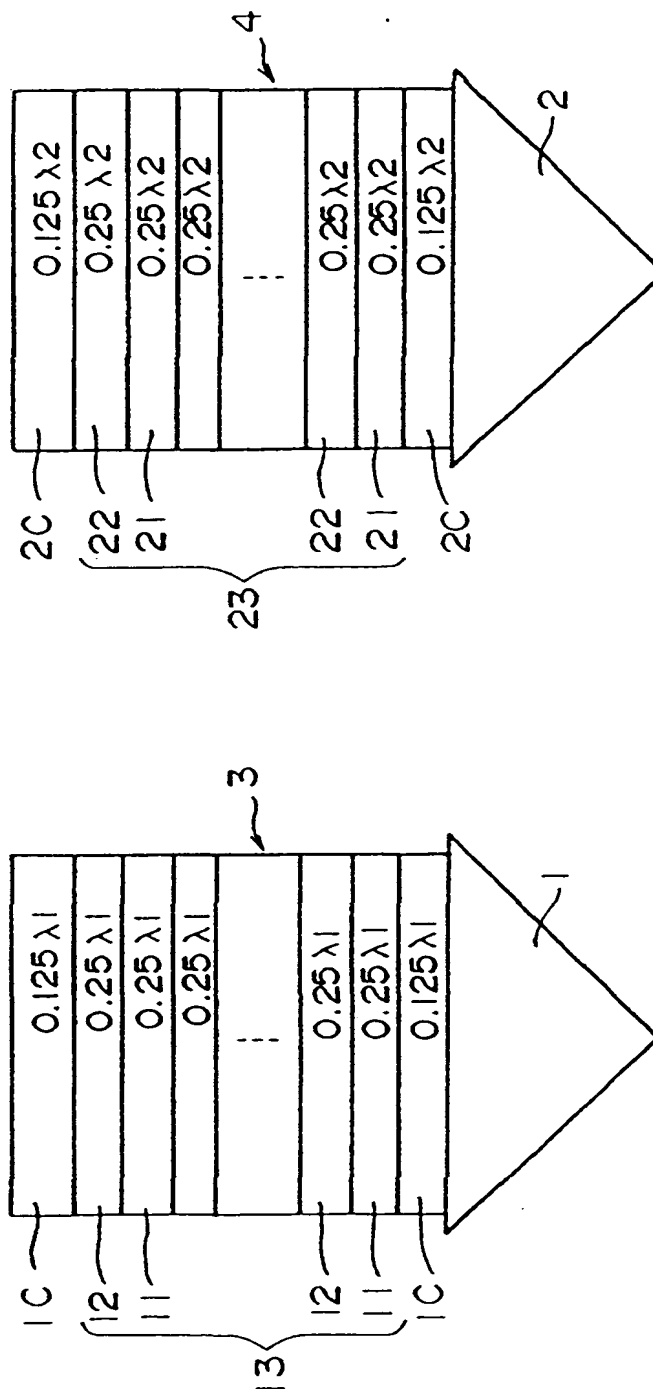


Fig.8



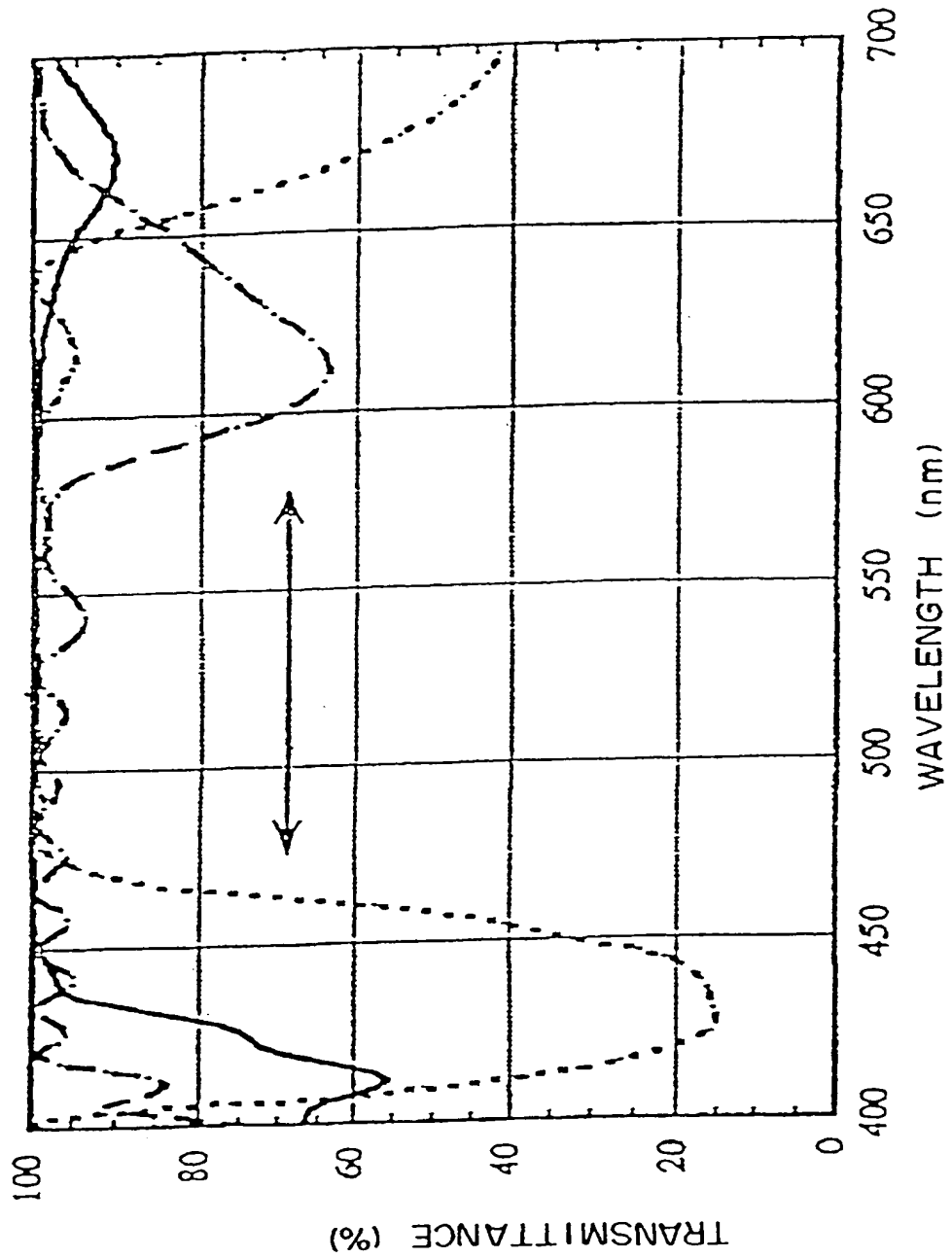


Fig.9

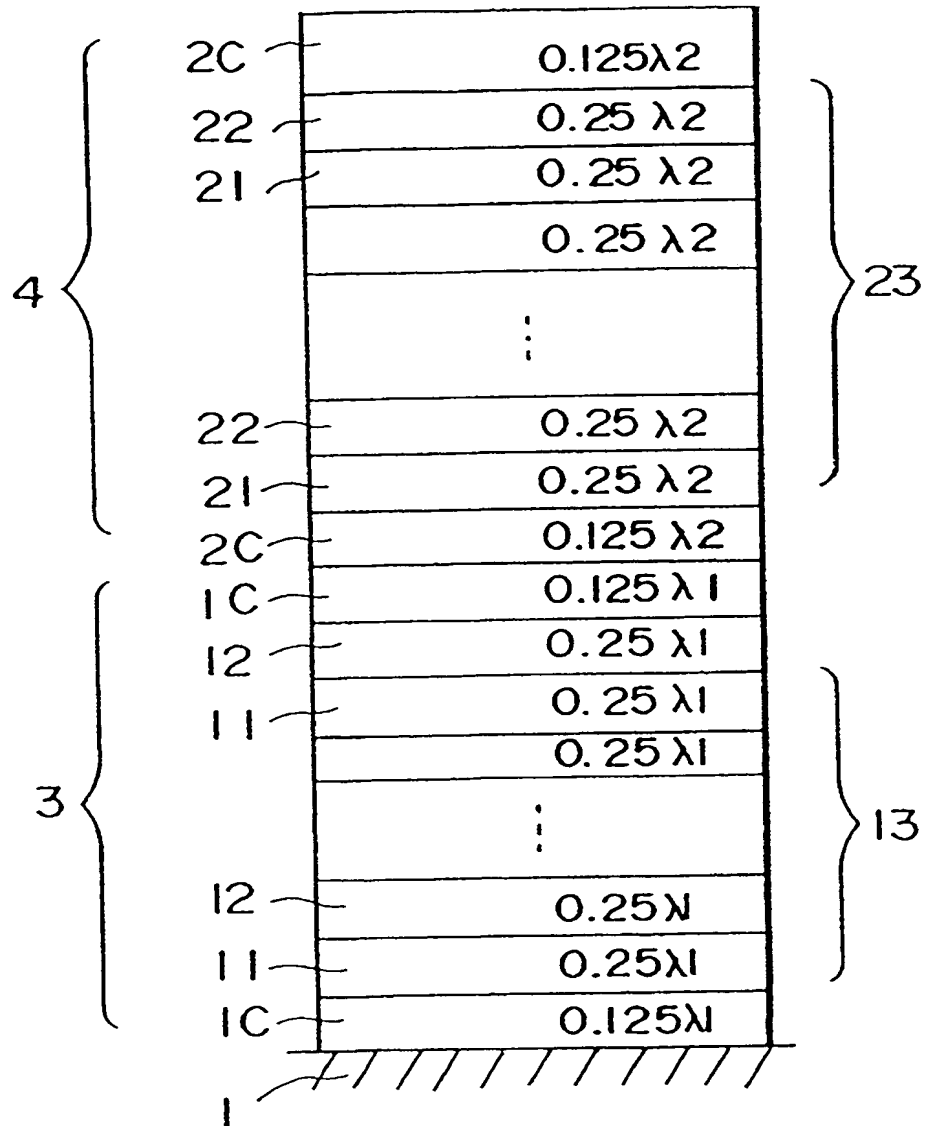


Fig.11

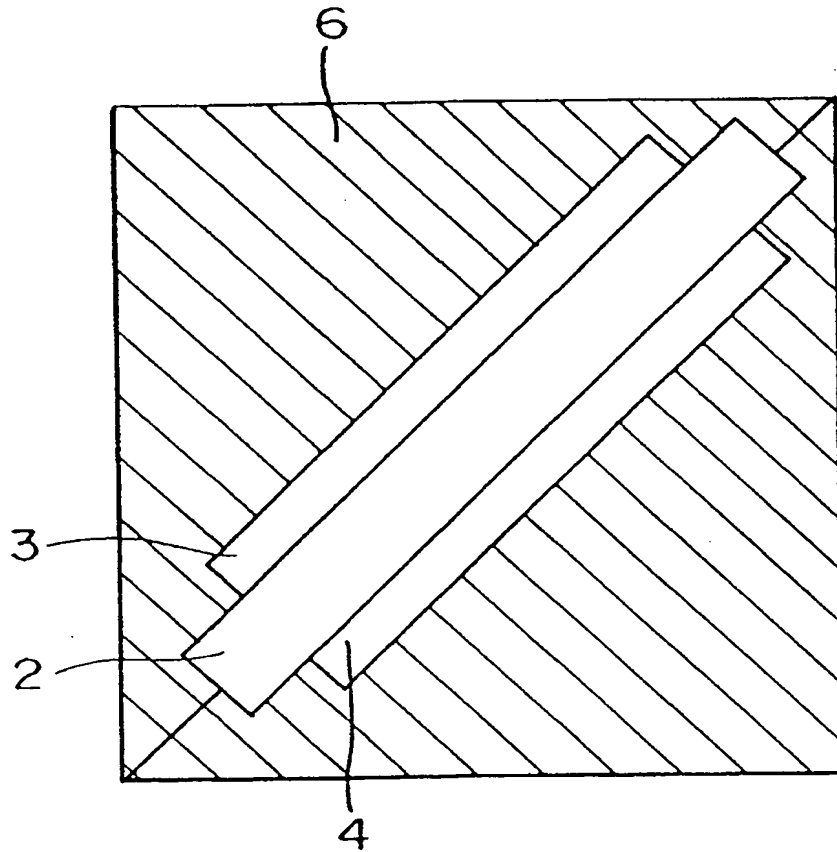


Fig.12

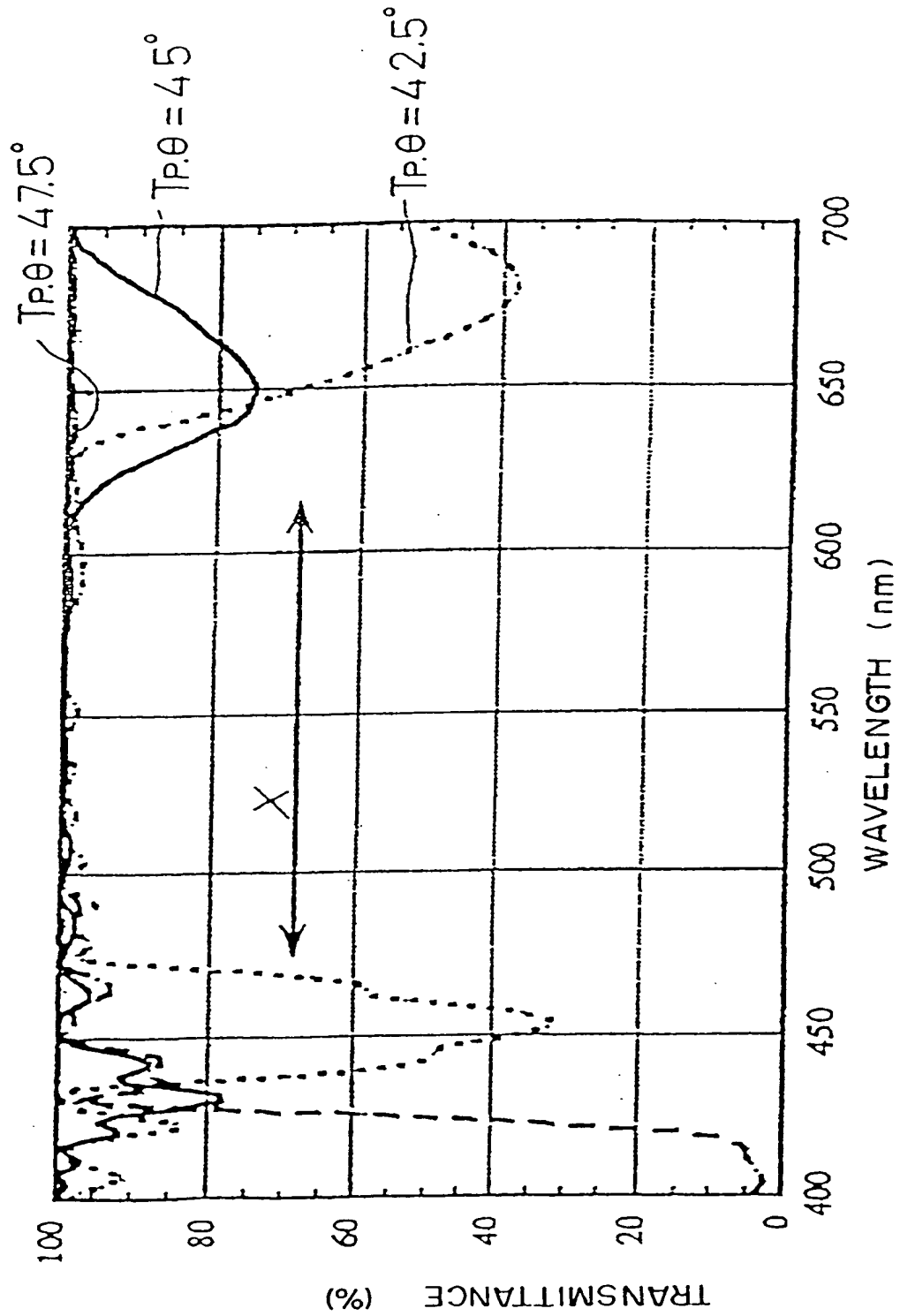


Fig.13

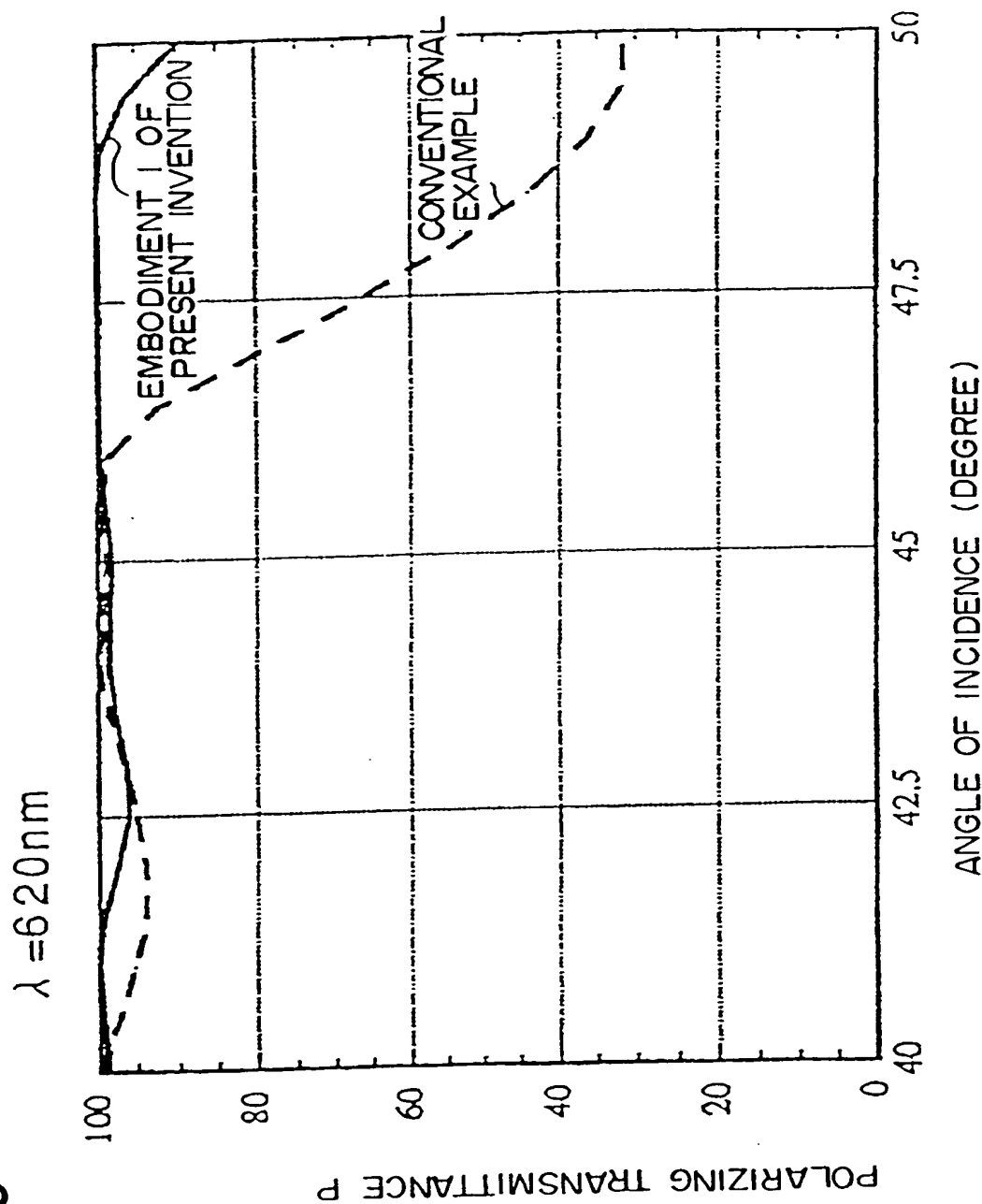


Fig.14

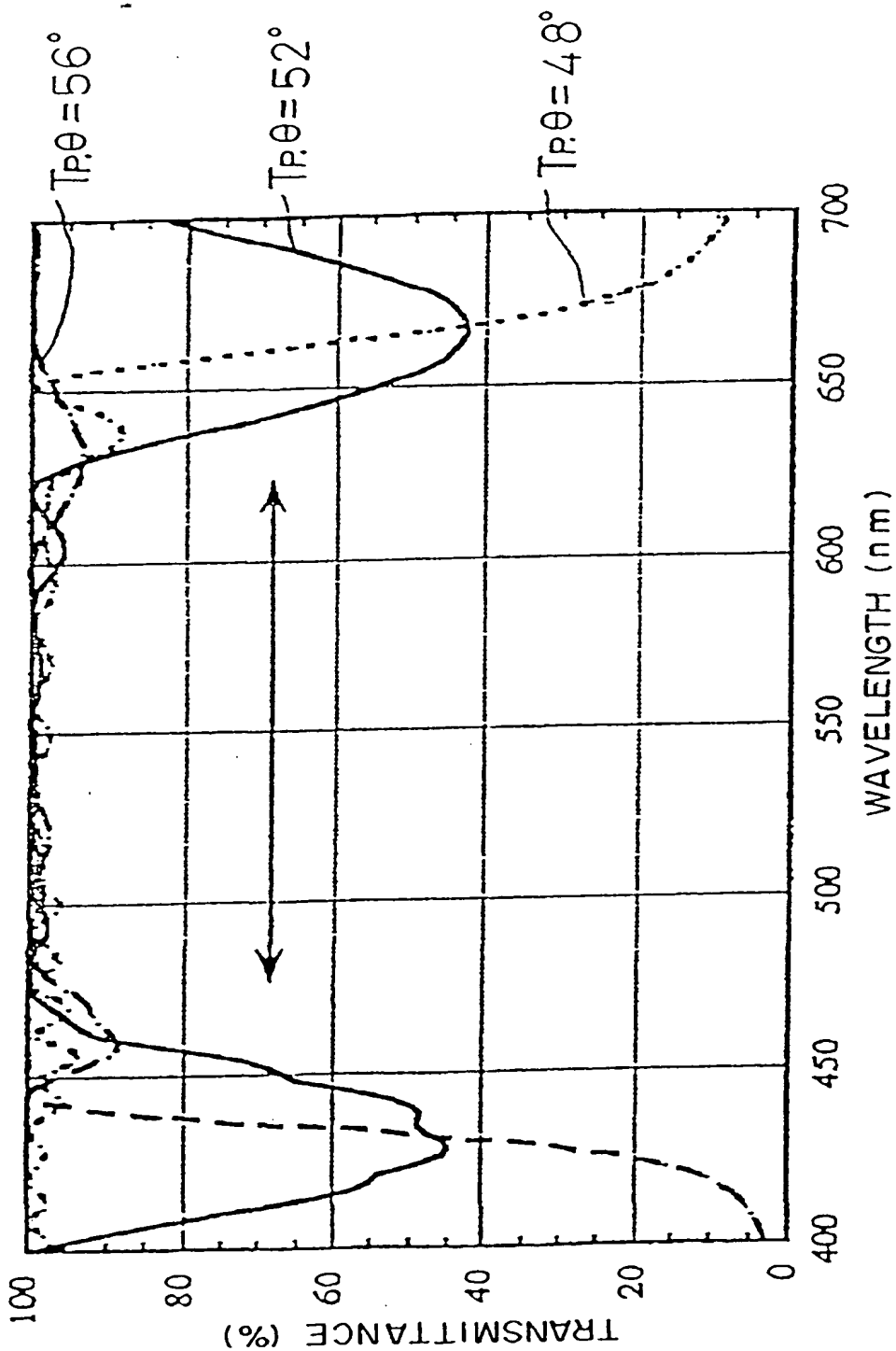


Fig.15

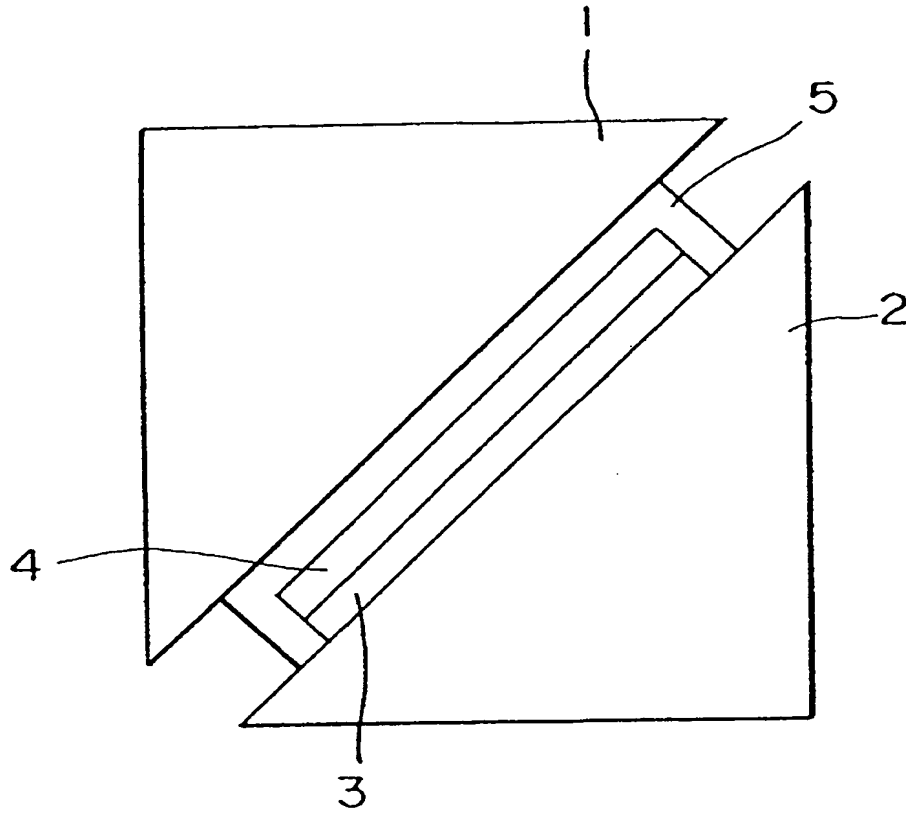


Fig.16
(Table 1)

LIST OF EXAMPLES (mol%, wt%)

| No. | 1 | | 2 | | 3 | | 4 | |
|---|-------|------|-------|------|-------|------|-------|------|
| | mol% | wt% | mol% | wt% | mol% | wt% | mol% | wt% |
| SiO ₂ | 52.7 | 23.9 | 52.7 | 23.8 | 52.7 | 23.8 | 52.7 | 23.8 |
| Na ₂ O | 1.9 | 0.9 | 1.9 | 0.9 | 1.9 | 0.9 | 1.9 | 0.9 |
| K ₂ O | 1.3 | 0.9 | 1.3 | 0.9 | 1.3 | 0.9 | 1.3 | 0.9 |
| PbO | 43.9 | 74.0 | 42.9 | 72.2 | 41.9 | 70.4 | 40.9 | 68.6 |
| PbF ₂ | — | — | 1.0 | 1.9 | 2.0 | 3.7 | 3.0 | 5.5 |
| Sb ₂ O ₃ | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 | 0.3 |
| K ₂ SiF ₆ | — | — | — | — | — | — | — | — |
| F/O (%) | — | | 1.31 | | 2.65 | | 4.00 | |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | +0.02 | | +0.02 | | +0.03 | | +0.01 | |
| REFRACTIVE INDEX n _d | 1.849 | | 1.845 | | 1.841 | | 1.837 | |
| WAVELENGTH CORR. TO TRANSMITTANCE OF 80% (nm) | 416 | | 411 | | 408 | | 404 | |

Fig.17
(Table 2)

LIST OF EXAMPLES (mol%, wt%)

| No. | 5 | | 6 | | 7 | | 8 | |
|---|-------|------|-------|------|-------|------|-------|------|
| | mol% | wt% | mol% | wt% | mol% | wt% | mol% | wt% |
| SiO ₂ | 52.7 | 23.8 | 52.7 | 23.7 | 52.7 | 23.6 | 52.7 | 23.5 |
| Na ₂ O | 1.9 | 0.9 | 1.9 | 0.9 | 1.9 | 0.9 | 1.9 | 0.9 |
| K ₂ O | 1.3 | 0.9 | 1.3 | 0.9 | 1.3 | 0.9 | 1.3 | 0.9 |
| PbO | 39.9 | 66.8 | 38.9 | 65.0 | 36.4 | 60.6 | 33.9 | 56.2 |
| PbF ₂ | 4.0 | 7.3 | 5.0 | 9.2 | 7.5 | 13.7 | 10.0 | 18.2 |
| Sb ₂ O ₃ | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 | 0.3 | 0.2 | 0.3 |
| K ₂ SiF ₆ | — | — | — | — | — | — | — | — |
| F/O (%) | 5.37 | | 6.75 | | 10.30 | | 13.98 | |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | +0.03 | | +0.03 | | +0.03 | | +0.04 | |
| REFRACTIVE INDEX n _d | 1.830 | | 1.826 | | 1.810 | | 1.798 | |
| WAVELENGTH CORR. TO TRANSMITTANCE OF 80% (nm) | 399 | | 394 | | 391 | | 388 | |

Fig.18
(Table 3)

LIST OF EXAMPLES (mol%, wt%)

| No. | 9 | | 10 | | 11 | | 12 | |
|---|-------|------|-------|------|-------|------|-------|------|
| | mol% | wt% | mol% | wt% | mol% | wt% | mol% | wt% |
| SiO ₂ | 52.1 | 23.2 | 52.1 | 22.9 | 52.1 | 22.9 | 45.7 | 19.0 |
| Na ₂ O | 2.0 | 0.9 | 2.0 | 0.9 | 2.0 | 0.9 | 2.0 | 0.9 |
| K ₂ O | — | — | — | — | — | — | 2.0 | 1.3 |
| PbO | 44.3 | 73.2 | 38.2 | 62.5 | 35.7 | 58.1 | 45.5 | 70.4 |
| PbF ₂ | 0.2 | 0.3 | 6.3 | 11.3 | 8.8 | 15.7 | — | — |
| Sb ₂ O ₃ | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 1.5 | 3.1 |
| K ₂ SiF ₆ | 1.3 | 2.1 | 1.3 | 2.1 | 1.3 | 2.1 | 3.3 | 5.3 |
| F/O (%) | 5.44 | | 14.10 | | 17.86 | | 13.62 | |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | +0.03 | | +0.04 | | +0.04 | | +0.03 | |
| REFRACTIVE INDEX n _d | 1.830 | | 1.798 | | 1.789 | | 1.810 | |
| WAVELENGTH CORR. TO TRANSMITTANCE OF 80% (nm) | 398 | | 386 | | 380 | | 390 | |

Fig.19
(Table 4)

LIST OF EXAMPLES (mol%, wt%)

| No. | 1 3 | | 1 4 | |
|---|-------|------|-------|------|
| | mol% | wt% | mol% | wt% |
| SiO ₂ | 45.2 | 19.8 | 40.0 | 17.5 |
| Na ₂ O | 5.1 | 2.3 | 0.5 | 0.2 |
| K ₂ O | 3.8 | 2.6 | — | — |
| KF | — | — | 15.6 | 10.7 |
| PbO | 40.3 | 65.4 | 41.4 | 67.5 |
| PbF ₂ | 4.2 | 7.5 | 2.5 | 4.1 |
| Sb ₂ O ₃ | 0.1 | 0.3 | — | — |
| K ₂ SiF ₆ | 1.3 | 2.1 | — | — |
| F/O (%) | 11.58 | | 16.90 | |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | +0.04 | | +0.04 | |
| REFRACTIVE INDEX n _d | 1.814 | | 1.748 | |
| WAVELENGTH CORR. TO TRANSMITTANCE OF 80% (nm) | 410 | | 396 | |

Fig.20
(Table 5)

| N o. | 2 1 | 2 2 | 2 3 | 2 4 |
|------------------|---------|---------|---------|---------|
| REFRACTIVE INDEX | 1. 8223 | 1. 8301 | 1. 8360 | 1. 8426 |
| | 2 5 | 2 6 | 2 7 | B K 7 |
| | 1. 8501 | 1. 8570 | 1. 8637 | 1. 5168 |

Fig.21
(Table 6)

| N o . | 2 2 | 2 5 | B K 7 |
|------------------------------------|---------|---------|---------|
| STRESS (N/cm ²) | 3 1 . 5 | 3 1 . 0 | 3 0 . 0 |
| DEGREE OF BIREFRINGENCE (nm/cm) | 9 . 4 5 | 0 . 3 1 | 8 3 . 4 |

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Fig.22

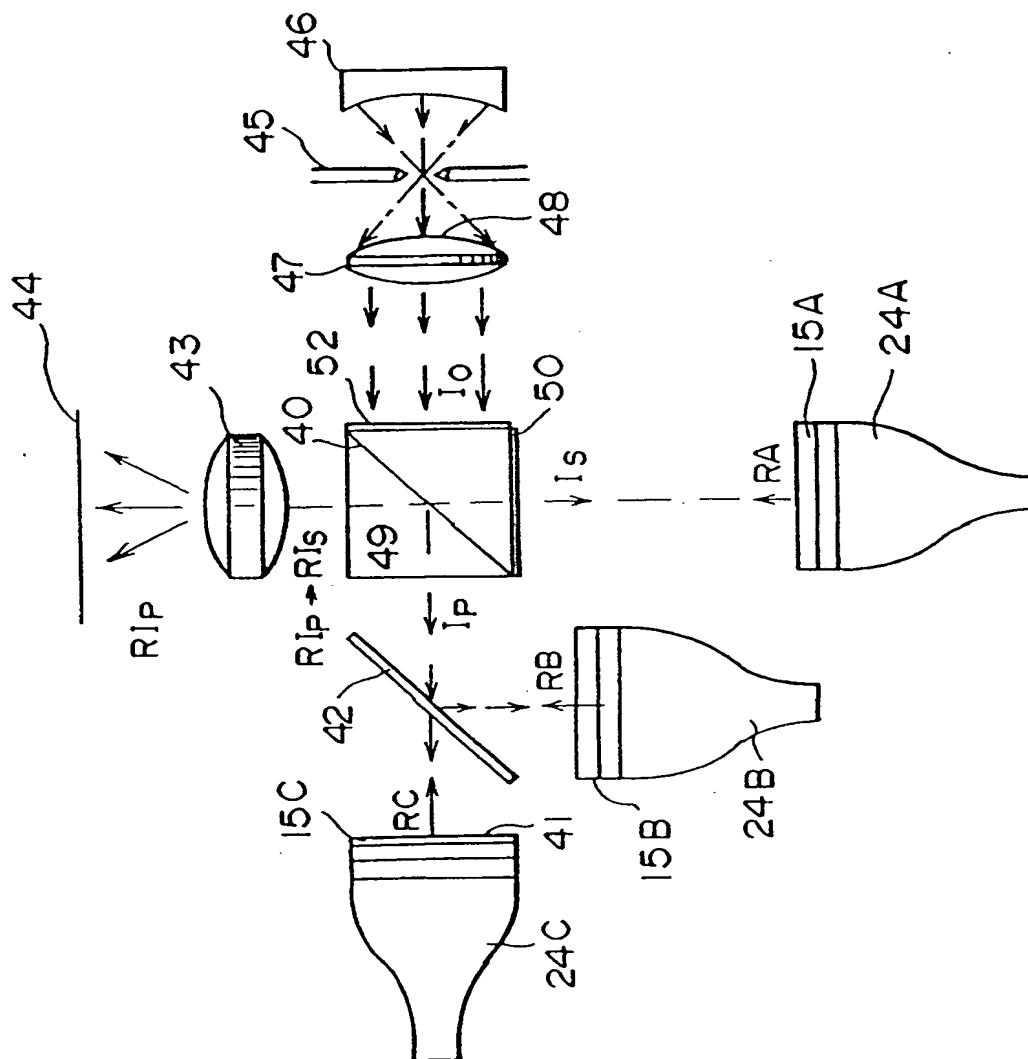
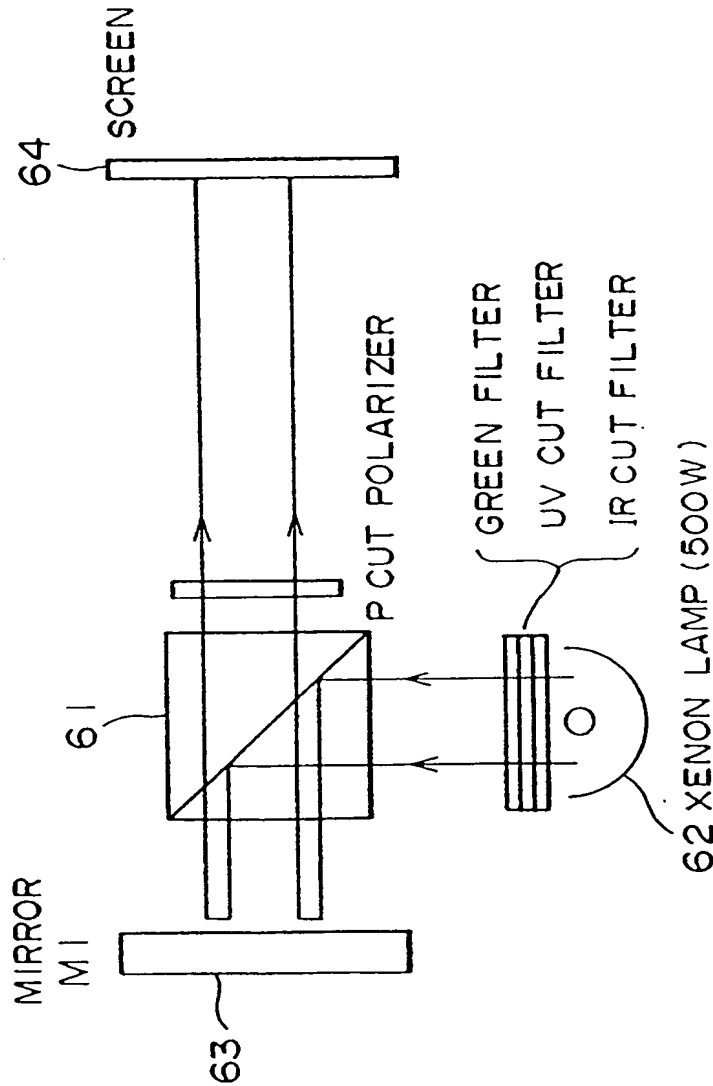


Fig. 23



EXTINCTION RATIO

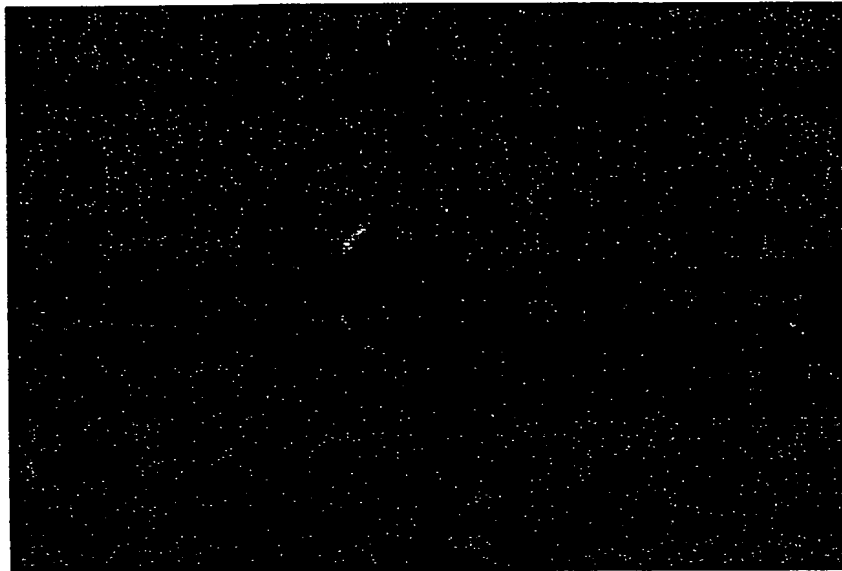
AVERAGE DATA WITH THE WAVELENGTH OF 480-610 nm AND

THE INCIDENT ANGLE OF $0^\circ, +6^\circ, -6^\circ$ DEGREES

TRANSMISSION : $T_P > 80\%$, $T_S \leq 0.02\%$ EXT. RATIO > 4000

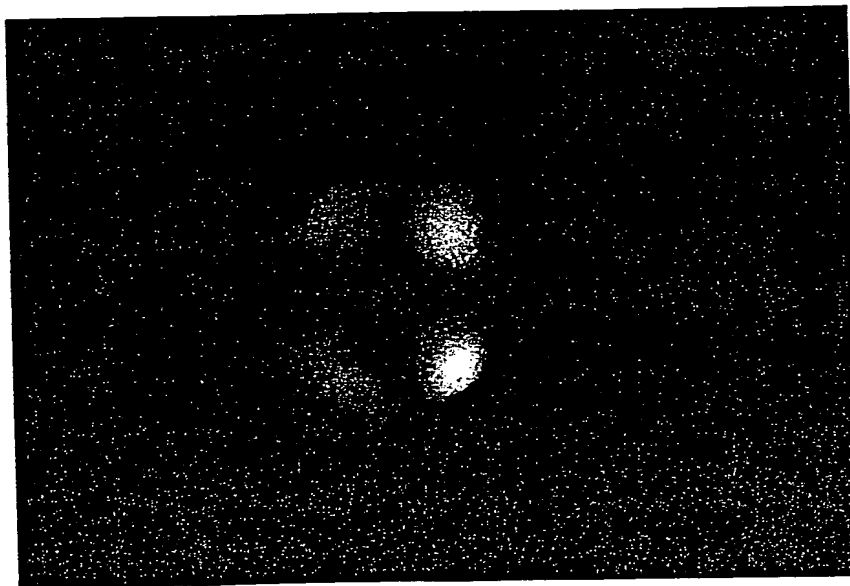
REFLECTION : $R_S > 80\%$, $R_P \leq 4\%$ EXT. RATIO > 20

Fig.24



NEW P B S (DISCERNIBLE SHAPE IS GHOST IMAGE)

Fig.25



CONVENTIONAL - TYPE P B S

Fig.26
(Table 7)

LIST OF EXAMPLES (wt%)

| No. | 2 1 | 2 2 | 2 3 | 2 4 |
|--|--------|--------|--------|--------|
| SiO ₂ | 2 5. 9 | 2 5. 4 | 2 4. 9 | 2 4. 4 |
| B ₂ O ₃ | — | — | — | — |
| Na ₂ O | 0. 9 | 0. 9 | 0. 9 | 0. 9 |
| K ₂ O | 0. 9 | 0. 9 | 0. 9 | 0. 9 |
| BaO | — | — | — | — |
| PbO | 7 2. 0 | 7 2. 5 | 7 3. 0 | 7 3. 5 |
| As ₂ O ₃ | — | — | — | — |
| Sb ₂ O ₃ | 0. 3 | 0. 3 | 0. 3 | 0. 3 |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | 0. 4 1 | 0. 3 0 | 0. 2 2 | 0. 1 0 |
| LINEAR EXPANSION COEFFICIENT (10 ⁻⁷ /K ⁻¹) | 8 8 | 9 0 | 9 1 | 9 1 |

Fig.27
(Table 8)

LIST OF EXAMPLES (wt%) cont.

| 番 号 | 2 5 | 2 6 | 2 7 | BK 7 |
|--|------|-------|-------|------|
| SiO ₂ | 23.9 | 23.4 | 22.9 | 68.9 |
| B ₂ O ₃ | — | — | — | 10.1 |
| Na ₂ O | 0.9 | 0.9 | 0.9 | 8.8 |
| K ₂ O | 0.9 | 0.9 | 0.9 | 8.4 |
| BaO | — | — | — | 2.8 |
| PbO | 74.0 | 74.5 | 75.0 | — |
| As ₂ O ₃ | — | — | — | 1.0 |
| Sb ₂ O ₃ | 0.3 | 0.3 | 0.3 | — |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | 0.01 | -0.07 | -0.12 | 2.78 |
| LINEAR EXPANSION COEFFICIENT (10 ⁻⁷ /K ⁻¹) | 9.3 | 9.3 | 9.4 | 8.3 |

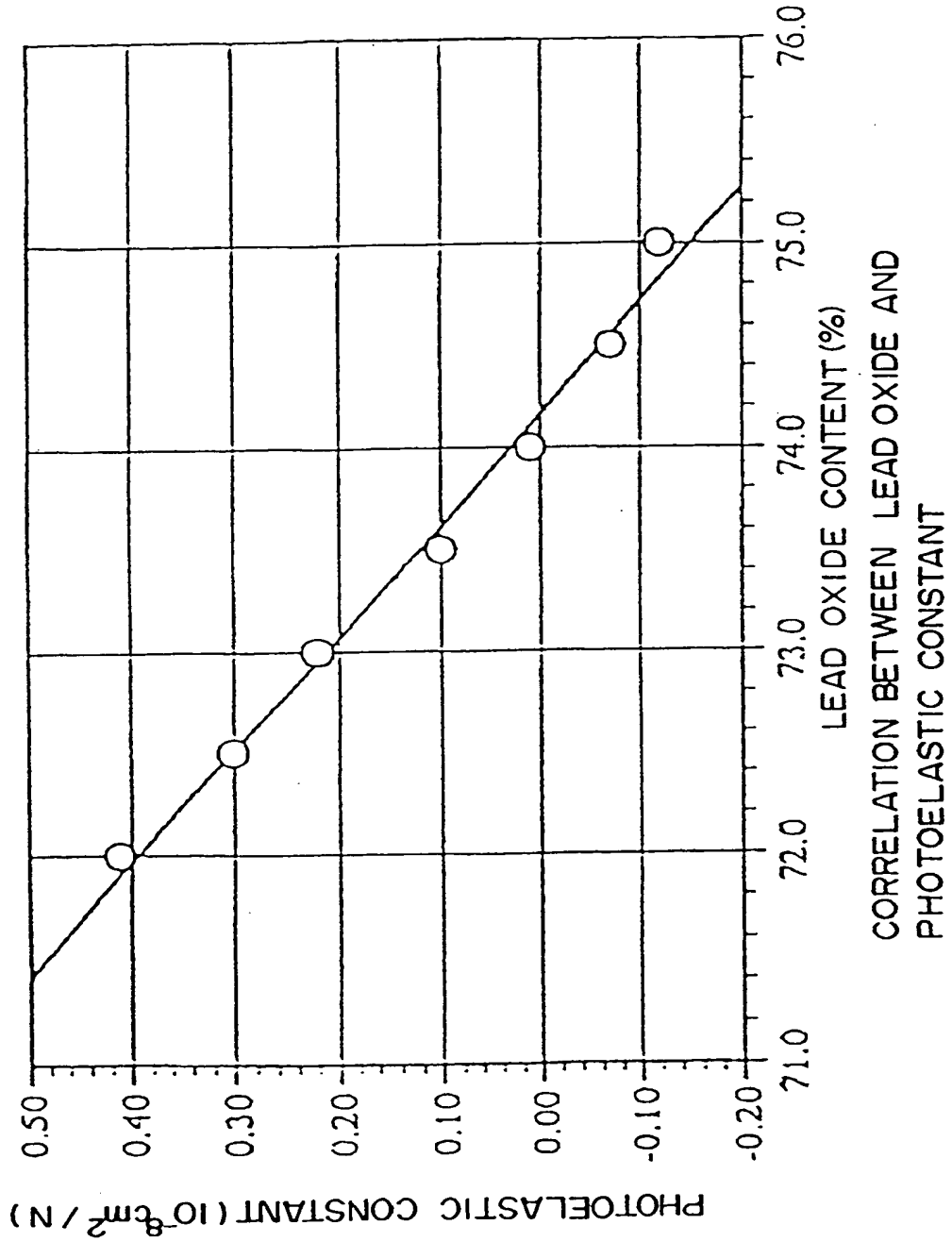


Fig.28

Fig.29

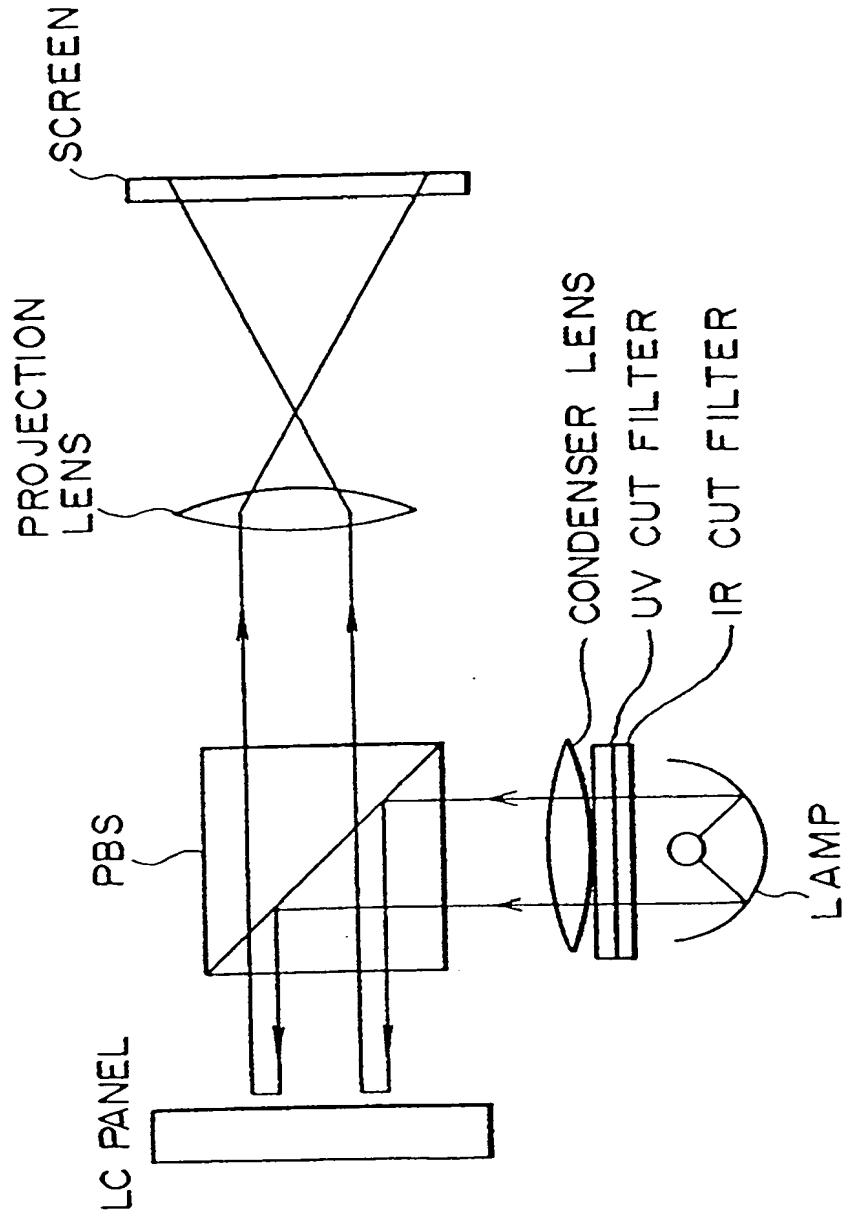


Fig.30
(Table 9)

| No. | A% | B | C |
|---|------|------|------|
| SiO ₂ | 24.9 | 24.9 | 24.9 |
| Na ₂ O | 0.9 | 0.9 | 0.9 |
| K ₂ O | 0.9 | 0.9 | 0.9 |
| PbO | 73.0 | 73.0 | 73.0 |
| As ₂ O ₃ | — | 0.3 | — |
| Sb ₂ O ₃ | 0.3 | — | — |
| PHOTOELASTIC CONSTANT (10 ⁻⁸ cm ² /N) | 0.22 | 0.22 | 0.23 |
| WAVELENGTH CORR.TO TRANSMITTANCE OF 80%(nm) | 393 | 396 | 424 |
| INTERNAL TRANSMITTANCE AT 400nm | 86 | 83 | 64 |

※This is the same as the optical glass No.23 indicated in Fig.26 (Table 7).

Fig.31

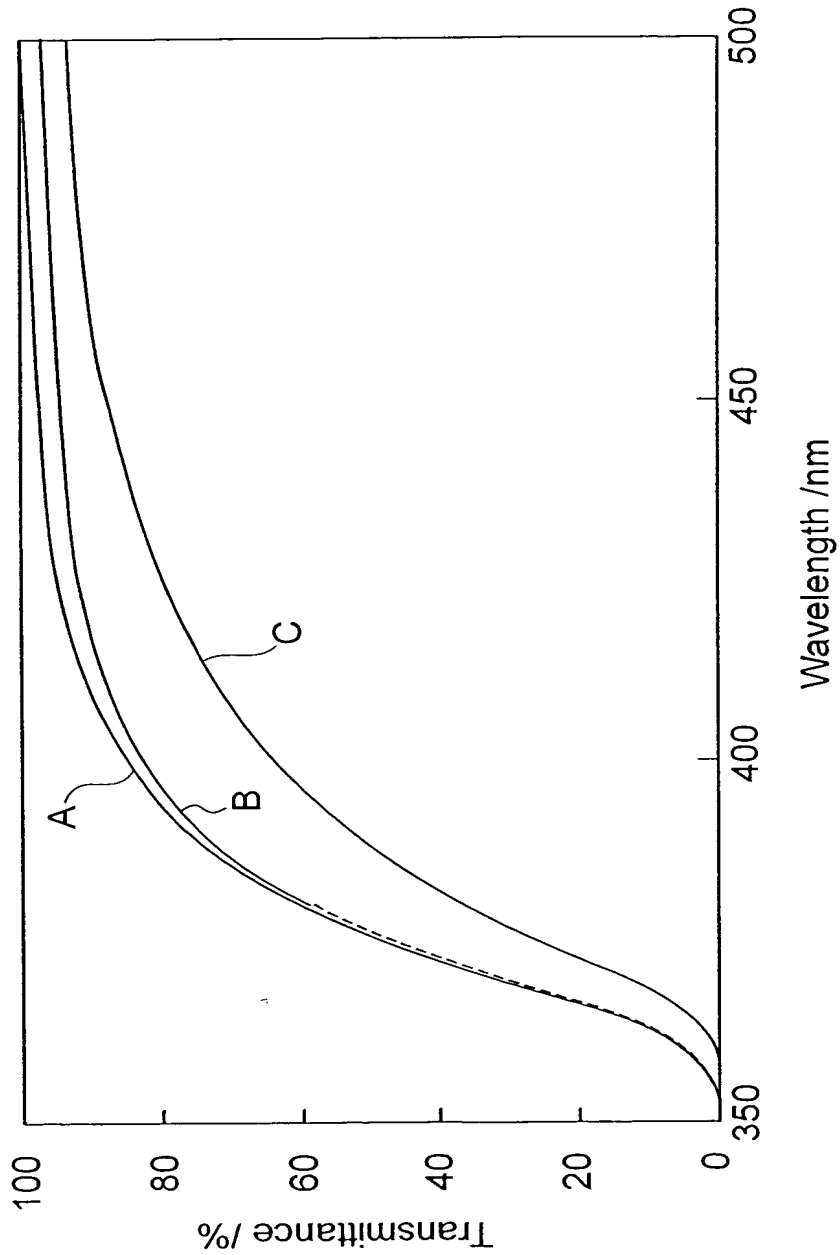


Fig.32
(Table 10) Results of measurement of photoelastic constants

| Glasses | Present * 1 invention | PDC6 | BK7 | DC5 | LAC8 | FC3 |
|---|--|--|--|--|--|--|
| Manufacturer | Nikon | Nikon | Nikon | Nikon | Nikon | Nikon |
| Refractive index(nd) | 1.837 | 1.5932 | 1.5168 | 1.5891 | 1.7130 | 1.4645 |
| Abbe's number(ν d) | 26.0 | 67.9 | 64.1 | 61.1 | 53.9 | 65.8 |
| Photoelastic constant ($10^{-8}\text{cm}^2/\text{N}$) | 0.01 | 0.52 | 2.85 | 2.29 | 1.98 | 4.09 |
| Main * 2 components | $\text{SiO}_2 \cdot \text{R}_2\text{O} \cdot$ $\text{PbO} \cdot \text{PbF}_2$ | $\text{P}_2\text{O}_5 \cdot \text{AlF}_3 \cdot$ $\text{RF}_2 \cdot \text{XF}_3$ | $\text{SiO}_2 \cdot \text{Al}_2\text{O}_3 \cdot$ $\text{R}_2\text{O} \cdot \text{RO}$ | $\text{SiO}_2 \cdot \text{B}_2\text{O}_3 \cdot$ $\text{Al}_2\text{O}_3 \cdot \text{RO}$ | $\text{B}_2\text{O}_3 \cdot \text{Al}_2\text{O}_3 \cdot$ $\text{RO} \cdot \text{X}_2\text{O}_3$ | $\text{SiO}_2 \cdot \text{B}_2\text{O}_3 \cdot$ $\text{Al}_2\text{O}_3 \cdot \text{KF}$ |
| Glasses | FK5 | SK16 | F2 | ZKN7 | SF2 | SF6 |
| Manufacturer | Schott | Schott | Schott | Schott | Schott | Schott |
| Refractive index(nd) | 1.4875 | 1.6204 | 1.6200 | 1.5085 | 1.6477 | 1.8052 |
| Abbe's number(ν d) | 70.4 | 60.3 | 36.4 | 61.2 | 33.9 | 25.4 |
| Photoelastic constant ($10^{-8}\text{cm}^2/\text{N}$) | 2.92 | 1.90 | 2.81 | 3.64 | 2.64 | 0.64 |

* 1: This is the same as the optical glass No.4 indicated in Fig.16 (Table 1).

* 2: "R" denotes an alkaline metal or an alkaline earth metal.

"X" denotes a rare earth metal.